

THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	)	
	)	
BEST, Adam Samuel, et al.	)	Confirmation No: 1281
	)	
Appn No.: 10/584,379	)	Art Unit: 1726
	)	
Filing Date: April 11, 2007	)	Examiner: L. Weiner
	)	
ELECTROCHEMICAL ELEMENT FOR USE AT	)	
<u>HIGH TEMPERATURES</u>	)	January 6, 2012

DO NOT ENTER: /LW/

COMMISSIONER FOR PATENTS  
Mailstop Amendments  
Alexandria, VA 22313-1450

/LW/ 01/10/2012

Dear Sir:

**RESPONSE TO OFFICE ACTION**

In response to the Office Action mailed October 7, 2011, please enter the following amendments and remarks.

**Amendments to the Claims** begin on page 2.

**Remarks** begin on page 6.

### CLAIM AMENDMENTS

Please replace the pending claims with the following:

1. (Previously presented) An electrochemical device comprising a cathode, an anode and an electrolyte arranged between the cathode and anode, wherein the electrolyte comprises an ionic liquid comprising an anion and a cation, which cation has the formula  $N$ -methyl- $N$ -hexyl-pyrrolidinium or pyrrolidinium ring structure,

wherein the active material of the cathode comprises as its major constituent by mass an intercalation material having an upper reversible-potential-limit of at most 4 V versus  $\text{Li}/\text{Li}^+$  and comprising any of the following compounds:  $\text{Li}_4\text{Ti}_5\text{O}_{12}$ ,  $\text{LiTi}_2\text{O}_4$ ,  $\text{Li}_{4-y}\text{Mg}_y\text{Ti}_5\text{O}_{12}$  ( $0 \leq y \leq 1$ ),  $\text{V}_2\text{O}_5$ ,  $\text{Li}_4\text{Mn}_5\text{O}_{12}$ , or  $\text{Li}_{4-y}\text{Mg}_y\text{Mn}_5\text{O}_{12}$  ( $0 \leq y \leq 1$ ).

2. (Previously presented) The electrochemical device of claim 1, wherein the electrochemical device is a primary battery or a rechargeable battery or an electrochemical capacitor.

3. (Previously presented) The electrochemical device of claim 1, wherein the electrochemical device is configured for use at a temperature between 50 and 200 °C .

4. (Previously presented) The electrochemical device of claim 3, wherein the electrochemical device is configured for use at a temperature between 60 and 200 °C.

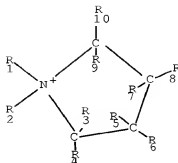
5. (Canceled)

6. (Canceled)

7. (Canceled)

8. (Previously presented) The electrochemical device of claim 1, wherein the

*N*-methyl-*N*-hexyl-pyrrolidinium-pyrrolidinium-structure is:



wherein  $R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, R_9, R_{10}$  are selected from the group consisting of: H, F, separate alkyl groups which may be branched, substituted and comprise heteroatoms, and separate phenyl groups which may be substituted and comprise heteroatoms.

9. (Previously presented) The electrochemical device of claim 1, wherein the anion of the ionic liquid comprises any of the following compounds:

$\text{ClO}_4^-$ ,  $\text{PF}_6^-$ ,  $\text{BF}_4^-$ ,  $\text{AsF}_6^-$ , a halogen ion,  $\text{N}(\text{CF}_3)_2^-$ ,  $\text{N}(\text{CF}_3\text{SO}_2)_2^-$ ,  $\text{CF}_3\text{SO}_3^-$ ,  $\text{N}(\text{CH}_3\text{SO}_2)_2^-$ ,

$\text{N}(\text{C}_2\text{F}_5\text{SO}_2)_2^-$ ,  $\text{B}(\text{C}_2\text{O}_4)_2^-$ , or  $\text{C}(\text{CF}_3\text{SO}_2)_3^-$ .

10. (Previously presented) The electrochemical device of claim 1, wherein the electrolyte further comprises a salt.

11. (Previously presented) The electrochemical device of claim 10, wherein the salt comprises an alkali salt.

12. (Previously presented) An electrochemical device comprising a cathode, an anode and an electrolyte arranged between the cathode and anode, wherein the electrolyte comprises an ionic liquid comprising an anion and a cation, which cation has a pyrrolidinium ring structure, wherein the active material of the cathode comprises as its major constituent by mass an intercalation material having an upper reversible-potential-limit of at most 4 V versus  $\text{Li}/\text{Li}^+$  and

comprising any of the following compounds:  $\text{Li}_4\text{Ti}_5\text{O}_{12}$ ,  $\text{LiTi}_2\text{O}_3$ ,  $\text{Li}_{4-y}\text{Mg}_y\text{Ti}_5\text{O}_{12}$  ( $0 \leq y < 1$ ),  $\text{V}_2\text{O}_5$ ,  $\text{Li}_4\text{Mn}_5\text{O}_{12}$ , or  $\text{Li}_{4-y}\text{Mg}_y\text{Mn}_5\text{O}_{12}$  ( $0 \leq y < 1$ ).

The electrochemical element of claim 10, wherein the electrolyte alkali salt comprises  $\text{MgCF}_3\text{SO}_2$  or  $\text{Mg}(\text{ClO}_4)_2$ .

13. (Cancelled)

14. (Cancelled)

15. (Previously presented) An electrochemical device comprising a cathode, an anode and an electrolyte arranged between the cathode and anode, wherein the electrolyte comprises an ionic liquid comprising an anion and a cation, wherein the cation has a pyrrolidinium ring structure, wherein the cathode comprises  $\text{LiCrTiO}_4$  as the major constituent by mass of the active material.

16. (Previously presented) An electrochemical device comprising a cathode, an anode and an electrolyte arranged between the cathode and anode, wherein the electrolyte comprises an ionic liquid comprising an anion and a cation, wherein the cation has a pyrrolidinium ring structure, wherein the cathode comprises  $\text{TiS}_2$  as the major constituent by mass of the active material.

17. (Previously presented) An electrochemical device comprising a cathode, an anode and an electrolyte arranged between the cathode and anode, wherein the which electrolyte comprises an ionic liquid comprising an anion and a cation, wherein the cation has a pyrrolidinium ring structure, wherein the cathode comprises  $\text{Li}_{1-y}\text{M}_y\text{FePO}_4$ , where  $\text{M}=\text{Mg}$ ,  $\text{Nb}$ ,  $\text{Zr}$ ,  $\text{Ti}$ , or  $\text{Al}$  and ( $0 \leq y \leq 0.02$ ), as the major constituent by mass of the active material.

18. (Cancelled)

19. (Cancelled)

20. (Cancelled)

21. (Cancelled)

22. (Previously presented) The electrochemical element of claim 1, wherein the cathode or anode comprises polyvinylidene fluoride (PVDF) as a binder material.

23. (Previously presented) The electrochemical element of claim 1, wherein the cathode or anode comprises polytetrafluoroethylene (PTFE) as a binder material.

24. (Canceled)

25. (Canceled)

26. (Canceled)

27. (New) The electrochemical device according to claim 15 wherein the electrochemical device is a primary battery or a rechargeable battery or an electrochemical capacitor.

28. (New) The electrochemical device according to claim 15 wherein the pyrrolidinium ring structure has the formula N-methyl-N-hexyl-pyrrolidinium.

29. (New) The electrochemical device according to claim 16 wherein the electrochemical device is a primary battery or a rechargeable battery or an electrochemical capacitor.

30. (New) The electrochemical device according to claim 16 wherein the pyrrolidinium ring structure has the formula N-methyl-N-hexyl-pyrrolidinium.

31. (New) The electrochemical device according to claim 17 wherein the electrochemical device is a primary battery or a rechargeable battery or an electrochemical capacitor.

32. (New) The electrochemical device according to claim 17 wherein the pyrrolidinium ring structure has the formula N-methyl-N-hexyl-pyrrolidinium.

#### REMARKS

Applicants acknowledge receipt of the final office action in which the Examiner rejected claims 1-5, 10-11, and 22-23 as anticipated by Ohzuku (US 7722989); rejected claims 1-6, 8-11, and 22-23 as obvious in view of Ohzuku in view of Hollenkamp (WO 2004/082059); rejected claims 19-20 under § 112, second paragraph; and indicated that claims 7, 12, and 15-17 would be allowable.

Applicants have amended the claims and respectfully submit that the case is now in condition for allowance.

#### Rejection of claims 1-5, 10-11, and 22-23 as anticipated by Ohzuku

Claim 1 has been amended to incorporate the limitation of former claim 7, which has been canceled. Because claim 7 was indicated to be allowable, claim 1 and the claims that depend from it are now allowable.

#### Rejection of claims 1-6, 8-11, and 22-23 as obvious in view of Ohzuku in view of Hollenkamp

As described above, claim 1 and the claims that depend from it are now allowable as a result of the amendment incorporating the limitation of former claim 7.

#### Rejection of claims 19-20 under § 112, second paragraph

Claims 19 and 20 have been canceled.

#### New Claims

Claims 27-32 have been added, which depend from allowable claims 15-17. Claims 27, 29, and 31 correspond to original claim 2 and claims 28, 30, and 32 correspond to original claim 7; therefore the new claims do not add new subject matter.

#### Allowable Claims

Claim 12 has been re-written in independent form and is therefore in condition for allowance. Amended claim 1 and its dependent claims are allowable.

Conclusion

Applicants believe that the present submission wholly responds to the office action and places all claims in condition for allowance. Applicants therefore respectfully request that the amendments be entered, the outstanding rejections be withdrawn, and the case passed to allowance.

If it would be helpful in resolving any remaining issues in the case, the Examiner is encouraged to contact the undersigned at the number below.

Respectfully submitted,  
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